UDC 666.247:536.34

UV-TRANSMISSION OF LOW-EMISSION GLASSES

O. A. Gladushko[1] and A. G. Chesnokov[1]

Translated from Steklo i Keramika, No. 1, pp. 12 – 13, January, 2006.

The level of transmission of sheet glasses with hard and soft low-emission coatings in the ultraviolet spectrum range is analyzed.

The analysis of optical characteristics of sheet glass performed at the Institute of Glass JSC [1] established a substantial discrepancy in ultraviolet transmission of glasses made by different manufacturers. The transmission coefficient in the UV spectrum range is not a standardized parameter in Russia or abroad, but it can be significant for a consumer in the Russian climate, considering that a certain dose of ultraviolet is required for the normal life activity of living organisms, as it facilitates appropriate exchanges processes in humans and animals and photosynthesis in plants [2]. It is also known that ultraviolet radiation has a dual effect on humans and animals: moderate doses have a favorable effect on living organisms, improve their metabolism and immunity to diseases, and increase general tonus and capacity for work. A shortage of ultraviolet may cause a pathological state called "solar starvation" or "UV deficit," deficiency of vitamin D, and infantile rickets. In contrast, excessive radiation may induce skin cancer.

For the majority of the Russian territory, especially the northern latitudes, an excess of ultraviolet is improbable. Its deficit is more probable. Therefore, the degree of access of ultraviolet radiation into interior spaces can be significant for glazing children's institutions, hospitals, hothouses, winter gardens, etc. In the past, an attempt was made to take into account this property when issuing natural lighting standards for interiors; however, such standards as SNiP 23-05–95 (Construction Norms and Regulations) were adopted when all glazing in the USSR was made of clear sheet glass produced by an identical process (vertical drawing) in accordance with general requirements (including requirements on the chemical composition of glass). Therefore, the characteristics of glass during that period could be regarded as approximately the same.

At present Russian consumers use diverse glasses produced in different countries and differing in their compositions and production technologies. Therefore, it is interesting to analyze the optical properties of glasses with coatings in the UV range, in particular, low-emission glasses. The advantages of such glass for heat shielding are obvious, however, they have some disadvantages, for instance, a decreased level of light transmission (wavelength range 380 – 780 nm); the light transmission of low-emission glasses on the average is 5 – 10% lower than the light transmission of initial sheet glass.

Researchers at the Institute of Glass JSC have measured in accordance with standard ISO 9050:2003 the integral transmission in the UV spectrum range (300 – 380 nm) of glass samples with low-emission coatings supplied by several companies for testing or expert evaluation. The specified wavelength range corresponds to short-range UV radiation known as zone A. The radiation in this precise range in certain doses has a favorable effect on living organisms. The harder radiation observed in zone B (290 – 320 nm), which also has a dual effect, actually cannot be transmitted via sheet glass. Short-wave UV radiation of zone C (10 – 290 nm) is lethal for living bodies, since it destroys protein molecules, but all UVC-radiation is absorbed in the upper atmosphere and does not reach the Earth's surface [2]. The results of measurements of ultraviolet and visible light transmission by glasses with various low-emission coatings are given in Table 1.

TABLE 1

Sample of company	Transmission, %		Emission coefficient	Thickness, mm	Coating
	ultraviolet	visible light			
1	31.0	86.0	0.04	3.90	Soft
2	38.0	80.0	0.10	3.81	″
3	40.0	86.0	0.08 – 0.09	3.85	″
4	54.0	84.5	0.15	3.85	Hard
5	32.0	67.5	0.16	3.90	Soft
6	15.0	84.0	0.59 – 0.61	3.90	″
7	25.0	85.5	0.09	3.80	″
8	53.0	84.0	0.21	3.10	Hard
9	49.5	82.0	0.13	3.90	Soft
10	22.0	83.0	0.09	3.85	″
11	56.0	84.0	0.20	3.10	Hard

[1] Institute of Glass Joint-Stock Co., Moscow, Russia.

The first notable fact following from data analysis is that generally UV transmission in glasses with coatings is significantly lower than in standard sheet glasses. Thus, glass grades M0 and M1 of thickness 4 mm used as initial materials for producing low-emission glasses transmit about 70% (66 – 73%) ultraviolet [1], whereas coated glasses of the same thickness transmit at best slightly more than 50%, i.e., the improvement in heat-shielding properties is accompanied by a certain loss in UV transmission. The particular UV transmission in glasses with hard coatings is 53 – 54%, whereas in glasses with soft coatings it varies from 15 to about 40% (except for one sample supplied by company 9).

Thus, although the particular transmission value of initial glasses is unknown, in general it can be stated that a more significant decrease in transmission (and more significant variance) is related to the use of soft coatings, which is presumably due to their technological specifics. The heat-shielding properties of glasses with hard coating are inferior to those of glasses with soft coatings: the emission coefficient of the former is 0.13 – 0.21 and that of the latter is 0.04 – 0.10. Here again the sample of company 9 is an exception, since it has a soft coating, but its UV transmission coefficient and emission coefficients are close to the parameters of hard coatings. A general conclusion is that a customer should make a balanced decision when selecting a low-emission glass: one should analyze glass properties depending on its purpose and either prefer glass with a lower level of heat shielding that allows a higher degree of ultraviolet into interior spaces (for instance, for a winter garden) or, on the contrary, select the maximum heat shielding if the amount of ultraviolet is not an issue.

An analysis of sanitary requirements with respect to the necessary access of ultraviolet and, moreover, particular recommendations are outside the scope of this paper. The purpose of this paper is to advise consumers of the existing variance in optical characteristics of glasses in the UV range and the need to take this factor into account in glazing design so that the consumer can make an intelligent choice. Perhaps, customers should require data on the transmission coefficient in the UV range from glass suppliers or this parameter should be determined at licensed testing centers for glazing in buildings, where ultraviolet transmission needs to be standardized.

REFERENCES

1. O. A. Gladushko and A. G. Chesnokov, “Relative optical characteristics of sheet glasses,” *Steklo Keram.*, No. 5, 5 – 6 (2005).
2. V. A. Belinskii and L. M. Andrienko, *Ultraviolet Radiation from the Sun and the Sky on the Earth Globe. Album of Maps, Nomograms, and Graphs* [in Russian], Izd-vo MGU, Moscow (1975).